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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new non-provisional applications under 37 CFR 1.53(b)

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ADDRESS TO: **Assistant Commissioner for Patents**
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Washington, D. C. 20231

APPLICATION ELEMENTS
See MPEP chapter 600 concerning utility patent application contents.

1. X Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)

2. X Specification (Total Pages 26)
(preferred arrangement set forth below)
- Descriptive Title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings (if filed)
- Detailed Description
- Claims
- Abstract of the Disclosure

3. X Drawings(s) (35 USC 113) (Total Sheets 8)

4. X Oath or Declaration (Total Pages 5)

a. ___ Newly Executed (Original or Copy)

b. ___ Copy from a Prior Application (37 CFR 1.63(d))
(for Continuation/Divisional with Box 17 completed) **(Note Box 5 below)**

i. ___ DELETIONS OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. ___ Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ___ Microfiche Computer Program (Appendix)

7. ___ Nucleotide and/or Amino Acid Sequence Submission

(if applicable, all necessary)

a. ___ Computer Readable Copy
b. ___ Paper Copy (identical to computer copy)
c. ___ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. _____ Assignment Papers (cover sheet & documents(s))
9. _____ a. 37 CFR 3.73(b) Statement (where there is an assignee)
_____ b. Power of Attorney
10. _____ English Translation Document (if applicable)
11. _____ a. Information Disclosure Statement (IDS)/PTO-1449
_____ b. Copies of IDS Citations
12. _____ Preliminary Amendment
13. X___ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
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04259.P003 Patent

UNITED STATES PATENT APPLICATION

for

SYSTEM AND METHOD FOR PERFORMING INTERLACED-TO-PROGRESSIVE CONVERSION USING INTERFRAME MOTION DATA

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SYSTEM AND METHOD FOR PERFORMING INTERLACED-TO-PROGRESSIVE CONVERSION USING INTERFRAME MOTION DATA

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates generally to the field of video conversion systems. More particularly, the invention relates to a system and method in which interframe motion compensation data generated during video image compression is used for performing interlaced-to-progressive video image conversion.

Description of the Related Art

Various types of video monitors reproduce images in an "interlaced" format (e.g., television monitors). A portion of an interlaced video monitor 140 is illustrated in **Figure 1**. As shown, the image scanned onto the monitor 140 may be separated into a plurality of even rows of pixels 150, 152, 154 etc., separated by an equal number of odd rows of pixels 151, 153, 155, etc. An electron scanning beam or other scanning apparatus (not shown) first scans all of the odd rows of pixels 151, 153, 155, etc., of the image in succession and – after the last odd row has been scanned – scans all of the even rows 150, 152, 154, etc. The scanning rate (i.e., the number of times even/odd row pairs are scanned in a second) for a standard television image is 30Hz in the United States and 25Hz in Europe.

An interlaced data stream 130, which the scanning apparatus reads to generate the interlaced video image 140, may be separated into sequential groups of odd 110 and even 120 video data. In **Figure 1**, odd video data group 110 and even video data group 120

within the data stream 130 comprise all of the information needed by the scanning apparatus to scan an entire video "frame" (a single image within the series of images that comprise the interlaced video).

The scanning apparatus in a non-interlaced or "progressive" video monitor does not scan odd lines followed by even lines as does the scanning apparatus of an interlaced monitor. Rather, in a progressive monitor, the scanning apparatus simply scans each row in succession (e.g., row 1, row 2, row 3, etc.) to reproduce each video frame.

Sometimes an interlaced video data stream must be converted so that it can be displayed on a progressive video monitor. This is accomplished using a scan converter 240 such as the one illustrated in **Figure 2**. For the purpose of illustration, the odd data group 110 and even data group 120 of data stream 130 have been further broken down into individual rows of video data (e.g., odd rows 211, 212 and even rows 221, 222). The scan converter 240 shuffles the data rows as illustrated so that new progressive data stream 230 includes data for reproducing the image by scanning the rows of pixels sequentially (i.e., odd row 211 followed by even row 221, followed by odd row 212 . . . etc).

One problem which occurs when converting an interlaced image to a progressive image is that image distortion or banding may occur. This problem is particularly noticeable when low resolution interlaced image is scaled up and converted to a higher resolution progressive image and/or when the elements which comprise the interlaced image are in motion (i.e., change position from one video frame to another).

For example, as illustrated in **Figure 3** a football 310 which comprises an element within an interlaced image may be moving at a relatively high rate across the interlaced video monitor 350 (in this case, in a horizontal, rightward direction). When the scan converter 240 converts the interlaced data 130 to progressive data 230, the reproduction of the football 310 on the progressive monitor 360 may show leftward image banding 320 and rightward image banding 321 (i.e., banding parallel to the motion of the element). This is because when the interlaced video data was originally generated the odd lines were scanned first (e.g., in the first 1/50 of a second), and then the even lines were scanned (e.g., in the second 1/60 of a second). Accordingly, for elements in motion such as football 310, the odd-row portion of the image 320 and the even-row portion of the image 321 may be spatially separated by the distance the football 310 traveled in 1/60 of a second.

Numerous image correction techniques have been developed to solve the foregoing problem (e.g., "line doubling" or other image data extrapolation mechanisms). All of these prior techniques, however, require a substantial amount of processing power and memory overhead to cure the foregoing image banding problem. For example, in order to extrapolate a corrected image from two separate groups of image data (i.e., the

even and odd image rows described above), the two groups of data must be concurrently stored in memory and analyzed in a relatively short period of time (e.g., before the next sequential frame is to be displayed). Accordingly such systems typically require complex, relatively expensive video processors and a great deal of fast access memory to store the successive frames to be analyzed.

In addition, such systems introduce a multi-frame delay in processing the video since multiple successive frames must be stored and analyzed before the first frame in the sequence can be displayed. This delay becomes more of a significant issue in audiovisual configurations which have separate audio and video systems (e.g., home theaters, video conferencing systems . . . etc). In such configurations, the multi-frame video delay may cause the video and audio to become unsynchronized (i.e., by an amount equal to the multi-frame delay). Although resynchronization is possible by adding a delay in the audio equal to the multi-frame delay, it requires audio hardware complex enough to include a delay feature and capable of precise calibration (e.g., calibration may need to be on the order of $1/10^{th}$ of a second or better to precisely synchronize lip motion in the video with speech).

Accordingly, what is needed is a system and method for converting between interlaced and progressive data which does not require the same processing and memory overhead needed in prior image correction systems. What is also needed is a system and method which will use preexisting data generated when the video is encoded, such as the interframe motion compensation data generated under the Motion Picture Experts Group (hereinafter "MPEG") compression algorithms (e.g., MPEG-1, MPEG-2 . . . etc). What

is also needed is a system and method which does not introduce a real-time delay when performing interlaced to progressive conversion.

SUMMARY OF THE INVENTION

An apparatus is described comprising: a decode unit which receives an encoded interlaced video signal including encoded interframe motion compensation data, and responsively transmits a decoded interlaced video signal and associated interframe motion compensation data; and a de-interlace unit which converts the interlaced video signal to a progressive video signal and which, responsive to the interframe motion compensation data, selects a region of the interlaced video signal for a different type of conversion, the selection based on the change in position of the region between successive video frames.

Also described is a method comprising the steps of: receiving an encoded interlaced video signal including encoded interframe motion compensation data, the interlaced video signal comprised of data for generating an interlaced video image, and the encoded interframe motion compensation data identifying a region of the interlaced video image; separating the interframe motion compensation data from the interlaced video signal; de-interlacing the region of the interlaced video image using a first de-interlace technique; and de-interlacing the remaining portions of the interlaced video image using a second de-interlace technique.

Also described is a method for converting an encoded video signal comprising the steps of: determining a source video data type encoded in the encoded video signal; determining whether the source video data type is one for which interframe motion data may be used for conversion; selecting a particular frame rate conversion ratio if the source video data type may be converted without use of the interframe motion

compensation data; and using the frame rate conversion ratio to convert each frame of the source video data type to one or more frames of a destination video data type.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the present invention can be obtained from the following detailed description in conjunction with the following drawings, in which:

FIG. 1 illustrates an interlaced video data stream and the corresponding even and odd rows of a video monitor.

FIG. 2 illustrates a scan converter for converting between interlaced and progressive video data.

FIG. 3 illustrates the effects of image banding when an interlaced image is converted to a progressive image.

FIG. 4 illustrates one embodiment of a system in which interframe motion compensation data is used by a de-interlace unit in one embodiment of the invention.

FIG. 5 illustrates the general type of interframe data encoded into a video data stream in one embodiment of the invention.

FIG. 6 illustrates a method implemented in accordance with one embodiment of the invention.

FIG. 7 illustrates a frame rate conversion system and method implemented in accordance with one embodiment of the invention.

FIG. 8 illustrates one embodiment of a system in which an interlacer is used to produce an interlaced video output signal.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In the following description for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent, however, to one skilled in the art that the present invention may be practiced without some of these specific details. In other instances, well-known structures and devices are shown in block diagram form to avoid obscuring the underlying principles of the invention.

Embodiments of the present invention includes various steps, which will be described below. The steps may be embodied in machine-executable instructions. The instructions can be used to cause a general-purpose or special-purpose processor which is programmed with the instructions to perform certain steps. Alternatively, these steps may be performed by specific hardware components (e.g., silicon chips) that contain hardwired logic for performing the steps, or by any combination of programmed computer components and custom hardware components.

Elements of the present invention may be provided as a computer program product which may include a machine-readable medium having stored thereon instructions which may be used to program a computer (or other electronic device) to perform a process. The machine-readable medium may include, but is not limited to, floppy diskettes, optical disks, CD-ROMs, and magneto-optical disks, ROMs, RAMs, EPROMs, EEPROMs, magnet or optical cards, or other type of media suitable for storing electronic instructions. Moreover, the present invention may also be downloaded as a

computer program product, wherein the program may be transferred from a remote computer (e.g., a server) to a requesting computer (e.g., a client) by way of data signals embodied in a carrier wave or other propagation medium via a communication link (e.g., a modem or network connection).

ONE EMBODIMENT OF A SYSTEM AND METHOD FOR PERFORMING INTERLACED-TO-PROGRESSIVE CONVERSION USING INTERFRAME MOTION DATA

The video data 410 in one embodiment of the system is encoded using a "Motion Picture Experts Group" video compression algorithm such as MPEG-1 or MPEG-2. The MPEG-2 format is currently used for encoding video on Digital Video Disks (hereinafter "DVDs"), and for encoding video transmissions by digital cable and satellite broadcast companies.

Compression algorithms such as MPEG-1 and MPEG-2 significantly reduce the bandwidth and storage capacity requirements for a video signal. For example, MPEG-2 is capable of compressing a standard 124 M-bit/second video bit rate down to about 3-15 M-bit/second. This level of compression is accomplished by removing redundant information from the video signal at the encoder prior to transmission, and re-inserting it at the decoder.

One compression technique employed by the MPEG codec is known as motion-compensated inter-frame prediction This technique exploits temporal redundancy by attempting to predict the frame to be coded from a previous frame (i.e., the previous frame is used as a "reference" frame for the current frame). More specifically, this

technique stores vector data which describes the motion of one or more regions of the video image. For example, as illustrated in **Figure 5**, the motion compensation data encoded in the MPEG data stream describes the horizontal motion of football 310.

One embodiment of a system for performing interlaced-to-progressive image conversion using interframe motion compensation data is illustrated in **Figure 4**. In this embodiment, a decoder unit 420, a de-interlace unit 430, and a scaler unit 440 all reside on the same processor chip 460. If should be noted, however, that various multi-chip configurations may be implemented without departing from the underlying principles of the invention.

The decoder 420 in this embodiment decodes a stream of interlaced video data and transmits the decoded video data to the de-interlace unit 430. In one specific embodiment, the decoder 420 is an MPEG-2 decoder and the encoded video data is MPEG-2 data. However, it should be noted that the present system and method may be implemented using any video compression technique which includes interframe motion compensation data as part of its encoding algorithm.

The de-interlace unit 430 of one embodiment uses the decoded interframe motion compensation data to determine which image regions are moving and which are not. Those images that are moving faster than a predetermined threshold rate are selected by the de-interlace unit for a different type of interlaced-to-progressive image correction. For example, in one embodiment of the system and method, if the spatial difference between successive frames of a particular image region (e.g., the football 310) is

significant enough, then the de-interlacer will reconstruct the region using only one group of interlaced row data (e.g., either the even row data or the odd row data, but not both). When only one group of interlaced data is used in this manner, the de-interlacer may interpolate to fill in the missing data rows.

By using pre-encoded motion compensation data in this manner, the present invention solves the problem of banding associated with interlaced-to-progressive conversion without the need for complex extrapolation techniques and/or high-powered microprocessors, and/or expensive high-speed memory systems to store the multiple frames to be analyzed. Essentially, rather than doing the motion analysis in the de-interlace unit 430, as is done in prior art de-interlacers, the de-interlace unit 430 utilizes the motion analysis that was done when the video signal was compressed.

The de-interlace unit 430 transmits the converted progressive image data to a scaler unit 440, which either increases or decreases the size of the image. For example, in one embodiment of the system and method, the encoded video data 410 read by the decoder unit 420 is at a standard television resolution of 480i (i.e., an interlaced format with 480 lines), a 480p signal (i.e. a progressive format with 480 lines) is produced by the de-interlace unit 430, and the image output by the scaler unit 440 is at a High Definition Television ("HDTV") standard such as 720p (i.e., a progressive format with 720 lines).

In another embodiment of the system and method, the encoded video data 410 read by the decoder unit 420 is at a High Definition television resolution of 1080i (i.e., an

interlaced format with 1080 lines), a 1080p signal (i.e. a progressive format with 1080 lines) is produced by the de-interlace unit 430, and the image output by the scaler unit 440 is at a standard definition standard such as 480p (i.e., a progressive format with 480p lines).

In another embodiment of the system and method, shown in Figure 8, an interlacer unit 860 is added as an output option, making it possible to output an interlaced format signal, as required by a particular application or display device. The interlace unit 860 converts the progressive signal output by scaler unit 840 to an interlaced signal. . Unlike interlaced-to-progressive conversion, which can result in image artifacts without special processing, progressive-to-interlace conversion is quite straightforward, and is well-known in the art. Since all lines, odd and even, are available in each progressive frame output by scaler unit 840, it is simply a matter of outputting the odd lines during the odd field of the output interlaced signal, and the even lines during the even field.

In this embodiment of the system and method, it is possible to convert one interlaced format to another without the motion artifacts normally associated with interlace-to-interlace conversion. For example, a decoded 480i standard definition TV signal is input to de-interlace unit 840, which produces a 480p signal. The scaler unit 840 scales the 480p signal and produces a 1080p signal. Then, the interlacer unit 860 interlaces the 1080p signal and produces a 1080i signal, and a 1080i signal is then output to the output display device. Since the units 810 through 850 operate precisely the same as units 410 through 450 from Figure 4, as previously described herein, the 480i input signal is converted to a 1080p signal without motion artifacts, and since interlacer 860

converts progressive to interlace (using prior art techniques), the resulting 480i to 1080i conversion is accomplished without motion artifacts.

In yet another embodiment of the system and method, a 1080i signal is converted to 480i. For example, a decoded 1080i standard definition TV signal is input to de-interlace unit 830, which produces a 1080p signal. The scaler unit 840 scales the 1080p signal and produces a 480p signal. Then, the interlacer unit 860 interlaces the 480p signal and produces a 480i signal, and a 480i signal is then output to the output display device. Since the units 810 through 850 operate precisely the same as units 410 through 450 from Figure 4, as previously described herein, the 1080i input signal is converted to a 1080p signal without motion artifacts, and since interlacer 860 converts progressive to interlace (using prior art techniques), the resulting 480i to 1080i conversion is accomplished without motion artifacts.

In one embodiment of the system and method, the MPEG-2 video stream is initially analyzed to determine if the type of source data is encoded in the stream. This is illustrated at step 610 in the flowchart of **Figure 6**. Many digital transmission schemes such as satellite, digital cable, digital broadcast, digital video disk and digital video tape provide this type of identification information as part of the transmitted MPEG-2 stream.

Once the encoded source data has been identified, a particular type of conversion is selected. Different conversion techniques will be applied depending on the underlying encoded signal. For example, if it is determined that the underlying signal is a standard television or video signal (at 620) then the type of interlaced-to-progressive conversion

described above may be performed (i.e., using interframe motion data). If, however, the source data is a standard 16 mm movie signal, then a different type of conversion may be applied.

One particular type of conversion is illustrated in **Figure 7**. For the purpose of illustration the frame rate for the source data selected in **Figure 7** is the frame rate for a standard 16 mm movie: 24 frames/second. The first step in the conversion process is to determine the conversion ratio that will be applied (at step 630). The conversion ratio is based on the frame rate of the source signal and the destination signal. For example, as illustrated, if the converted signal 720 requires a frame rate of 48 frames/second, then there is a 48:24 or a 2:1 conversion ratio. As such, every frame in the 24 frame/second signal will be converted to two frames in the 48 frame/second signal 720.

Similarly, if the converted signal requires a frame rate of 60 frames/second, then a 24:60 or 2:5 conversion ration will be applied. This means that every two frames of the source signal will be used to generate five frames of the destination signal. Thus, frame 1 from signal 710 will be converted to three frames of signal 730; frame 2 of signal 710 will be converted to two frames of signal 730, . . . and so on.

Accordingly, by determining the type of source signal encoded in the MPEG-2 stream before converting, the processor and memory requirements for performing the conversion are significantly reduced. If the signal is one which requires interpolation, then the interframe motion data encoded in the underlying MPEG-2 stream will be used to perform the conversion (as set forth in detail above). If, however, the conversion does

not require this type of processing, then alternative conversion techniques may be applied (e.g., frame rate conversion techniques such as those set forth in **Figures 6** and **7**).

Throughout the foregoing description, for the purposes of explanation, numerous specific details were set forth in order to provide a thorough understanding of the present system and method. It will be apparent, however, to one skilled in the art that the system and method may be practiced without some of these specific details. Accordingly, the scope and spirit of the invention should be judged in terms of the claims which follow.

CLAIMS

What is claimed is:

1. An apparatus comprising:

a decode unit which receives a first encoded interlaced video signal including encoded interframe motion compensation data, and responsively transmits a decoded interlaced video signal and associated interframe motion compensation data; and

a de-interlace unit which converts said first interlaced video signal to a first progressive video signal, and which, responsive to said interframe motion compensation data, selects a region of said first interlaced video signal for a different type of conversion, said selection based on the change in position of said region between successive video frames.

2. The apparatus as claimed in claim 1 wherein said encoded first interlaced video signal is an MPEG-2 signal.

3. The apparatus as claimed in claim 1 wherein said encoded first interlaced video signal is an MPEG-1 signal.

4. The apparatus as claimed in claim 1 further including a scaling unit which converts said first progressive video signal to a second progressive video signal at a different resolution.

5. The apparatus as claimed in claim 4 wherein said first interlaced signal is a standard television signal and said second progressive video signal is an HDTV signal.

6. The apparatus as claimed in claim 5 wherein said standard television signal is a 480i signal and said HDTV signal is a 720p signal.

7. The apparatus as claimed in claim 5 wherein said standard television signal is a PAL standard video signal and said HDTV signal is a 720p signal.

8. The apparatus as claimed in claim 4 wherein said first interlaced signal is an HDTV signal and said second progressive video signal is an HDTV signal.

9. The apparatus as claimed in claim 8 wherein said interlaced HDTV signal is a 1080i and said progressive HDTV signal is a 720p signal.

10. The apparatus as claimed in claim 4 further including a interlacer unit which converts said second progressive video signal to a second interlaced video signal.

11. The apparatus as claimed in claim 10 wherein said first interlaced signal is a standard television signal and said second interlaced video signal is an HDTV signal.

12. The apparatus as claimed in claim 11 wherein said standard television signal is a 480i signal and said HDTV signal is a 1080i signal.

13. The apparatus as claimed in claim 11 wherein said standard television signal is a PAL standard video signal and said HDTV signal is a 1080i signal.

14. The apparatus as claimed in claim 10 wherein said first interlaced signal is an HDTV television signal and said second interlaced video signal is a standard definition TV signal.

15. The apparatus as claimed in claim 14 wherein said standard television signal is a 480i signal and said HDTV signal is a 1080i signal.

16. The apparatus as claimed in claim 14 wherein said standard television signal is a PAL standard signal and said HDTV signal is a 1080i signal.

17. A method comprising the steps of:

receiving a first encoded interlaced video signal including encoded interframe motion compensation data, said first interlaced video signal comprised of data for generating an interlaced video image, and said encoded interframe motion compensation data identifying motion of a region of said interlaced video image;

separating said interframe motion compensation data from said first interlaced video signal;

de-interlacing said region of said first interlaced video image using a first de-interlace technique; and

de-interlacing the remaining portions of said first interlaced video image using a second de-interlace technique.

18. The method as claimed in claim 17 wherein said encoded interlaced video signal is an MPEG-2 signal.

19. The method as claimed in claim 17 wherein said encoded interlaced video signal is an MPEG-1 signal.

20. The apparatus as claimed in claim 17 wherein said first de-interlace technique comprises selecting only even or only odd row data of said interlaced data.

21. The apparatus as claimed in claim 20 including the step of interpolating between said selected even or odd interlaced rows.

22. The apparatus as claimed in claim 17 further including the step of scaling said de-interlaced region of said first interlaced image and said remaining de-interlaced portions of said interlaced image to a first progressive video signal at a different resolution.

23. The apparatus as claimed in claim 22 wherein said first interlaced signal is a standard television signal and said first progressive video signal is an HDTV signal.

24. The apparatus as claimed in claim 23 wherein said standard television signal is a 480i signal and said HDTV signal is a 720p signal.

25. The apparatus as claimed in claim 23 wherein said standard television signal is a PAL standard video signal and said HDTV signal is a 720p signal.

26. The apparatus as claimed in claim 22 wherein said first interlaced signal is an HDTV television signal and said first progressive video signal is a standard definition signal.

27. The apparatus as claimed in claim 26 wherein said standard television signal is a 480i signal and said HDTV signal is a 720p signal.

28. The apparatus as claimed in claim 26 wherein said standard television signal is a PAL standard video signal and said HDTV signal is a 720p signal.

29. The apparatus as claimed in claim 22 further including the step of interlacing said first progressive video into a second interlaced video signal.

30. The apparatus as claimed in claim 26 wherein said first interlaced signal is a standard television signal and said second interlaced video signal is an HDTV signal.

31. The apparatus as claimed in claim 26 wherein said standard television signal is a 480i signal and said HDTV signal is a 1080i signal.

32. The apparatus as claimed in claim 26 wherein said standard television signal is a PAL standard video signal and said HDTV signal is a 1080i signal.

33. The apparatus as claimed in claim 22 wherein said first interlaced signal is an HDTV television signal and said second interlaced video signal is a standard definition signal.

34. The apparatus as claimed in claim 33 wherein said standard television signal is a 480i signal and said HDTV signal is a 1080i signal.

35. The apparatus as claimed in claim 26 wherein said standard television signal is a PAL standard video signal and said HDTV signal is a 1080i signal.

36. The apparatus as claimed in claim 1 wherein said different type of conversion comprises selecting only even or only odd rows of said first interlaced data to generate said first progressive data.

37. The apparatus as claimed in claim 10 wherein said de-interlace unit interpolates between said selected even or odd interlaced rows.

38. A method for converting an encoded video signal comprising the steps of:

determining a source video data type encoded in said encoded video signal;

determining whether said source video data type is one for which interframe motion data should be for conversion;

selecting a particular frame rate conversion ratio if said source video data type may be converted without use of said interframe motion compensation data; and

using said frame rate conversion ratio to convert each frame of said source video data type to one or more frames of a destination video data type.

39. The method for converting an encoded video signal as claimed in claim 38 wherein said encoded video signal is an MPEG-2 signal.

40. The method for converting an encoded video signal as claimed in claim 38 wherein said encoded video signal is an MPEG-1 signal.

41. The method for converting an encoded video signal as claimed in claim 38 including the additional step of using said interframe motion data for conversion if said source video data type is one for which interframe motion data should be used.

42. The method for converting an encoded video signal as claimed in claim 41 wherein said interframe motion compensation data is used to identify regions of said source video data type which are in motion.

43. The method for converting an encoded video signal as claimed in claim 42 including the additional step of converting said identified regions using a different conversion technique from the remaining portions of said source video data type.

44. The method for converting an encoded video signal as claimed in claim 43 wherein said source video data type is an interlaced video data type and said destination video data type is a progressive video data type.

45. The method for converting an encoded video signal as claimed in claim 44 wherein said interlaced video data type is a 480i standard definition television signal.

46. The method for converting an encoded video signal as claimed in claim 44 wherein said interlaced video data type is a PAL format standard definition television signal.

47. The method for converting an encoded video signal as claimed in claim 44 wherein said interlaced video data type is a 1080i format HDTV signal.

48. The method for converting an encoded video signal as claimed in claim 38 wherein said source video data type is a 24 frame/second movie encoded as a 480i standard definition video signal.

49. The method for converting an encoded video signal as claimed in claim 48 wherein said destination video signal is a 60 frame/second signal.

50. An apparatus comprising:

a de-interlacer, which converts an interlaced video signal to a progressive scan video signal, responsive to interframe motion compensation data from a compressed video signal.

51. The apparatus as claimed in claim 50, wherein said compressed video signal is a compressed version of said interlaced video signal.

52. A method for utilizing interframe motion compensation data of a compressed first interlaced video signal as an input to the process of de-interlacing the said first interlaced video signal.

ABSTRACT

An apparatus is described comprising: a decode unit which receives an encoded interlaced video signal including encoded interframe motion compensation data, and responsively transmits a decoded interlaced video signal and associated interframe motion compensation data; and a de-interlace unit which converts the interlaced video signal to a progressive video signal, and which, responsive to the interframe motion compensation data, selects a region of the interlaced video signal for a different type of conversion, the selection based on the change in position of the region between successive video frames.

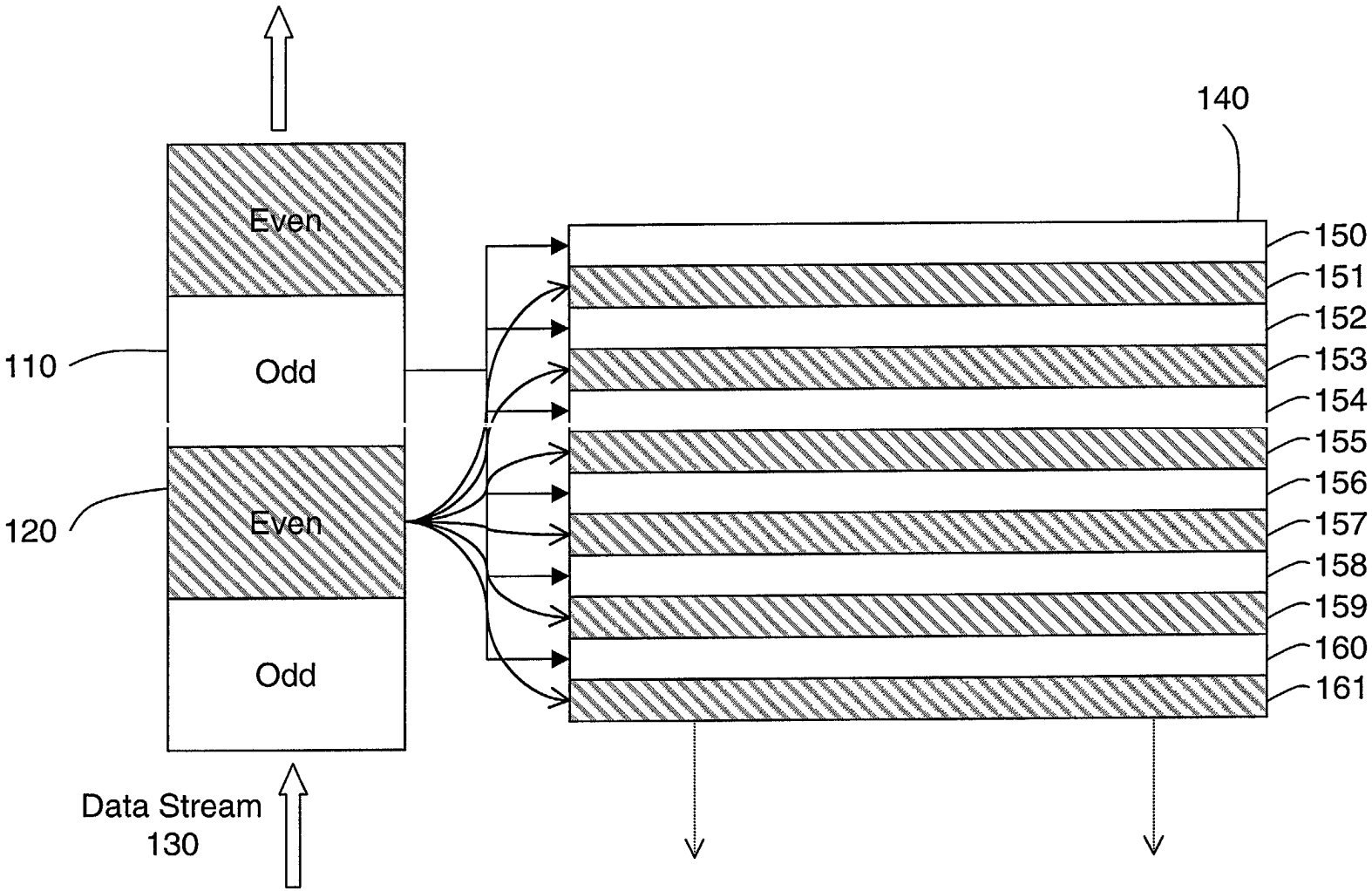

FIG. 1

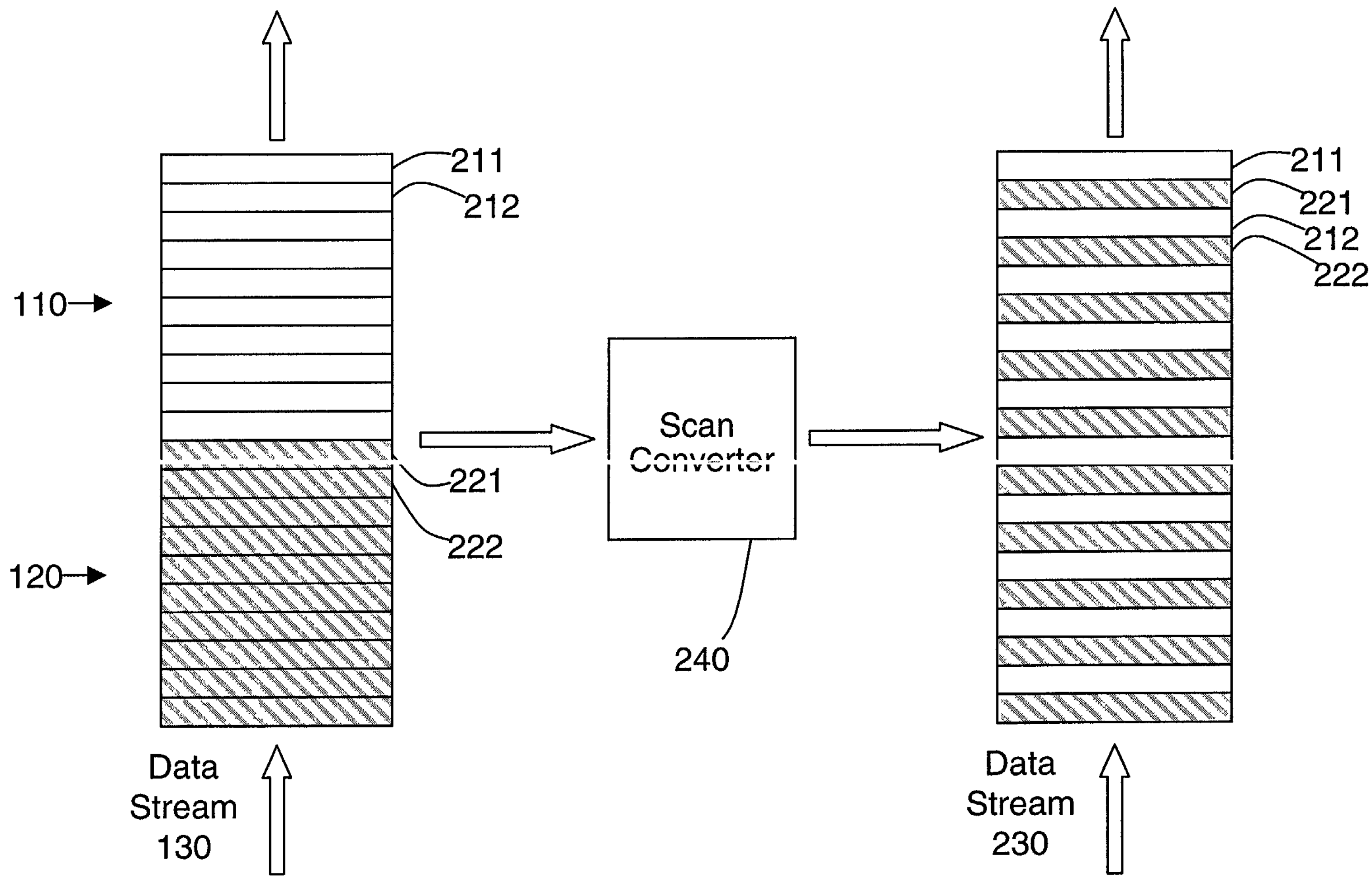

FIG. 2

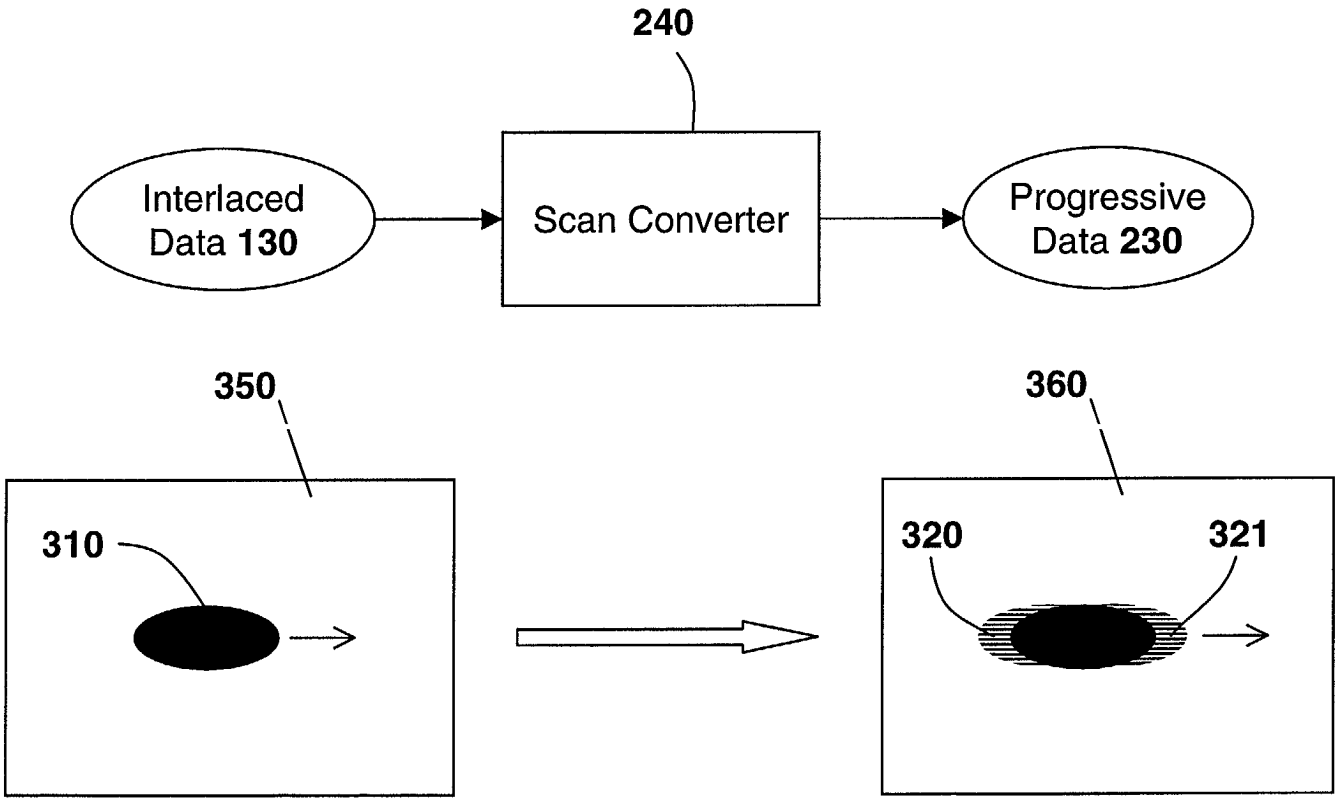

FIG. 3

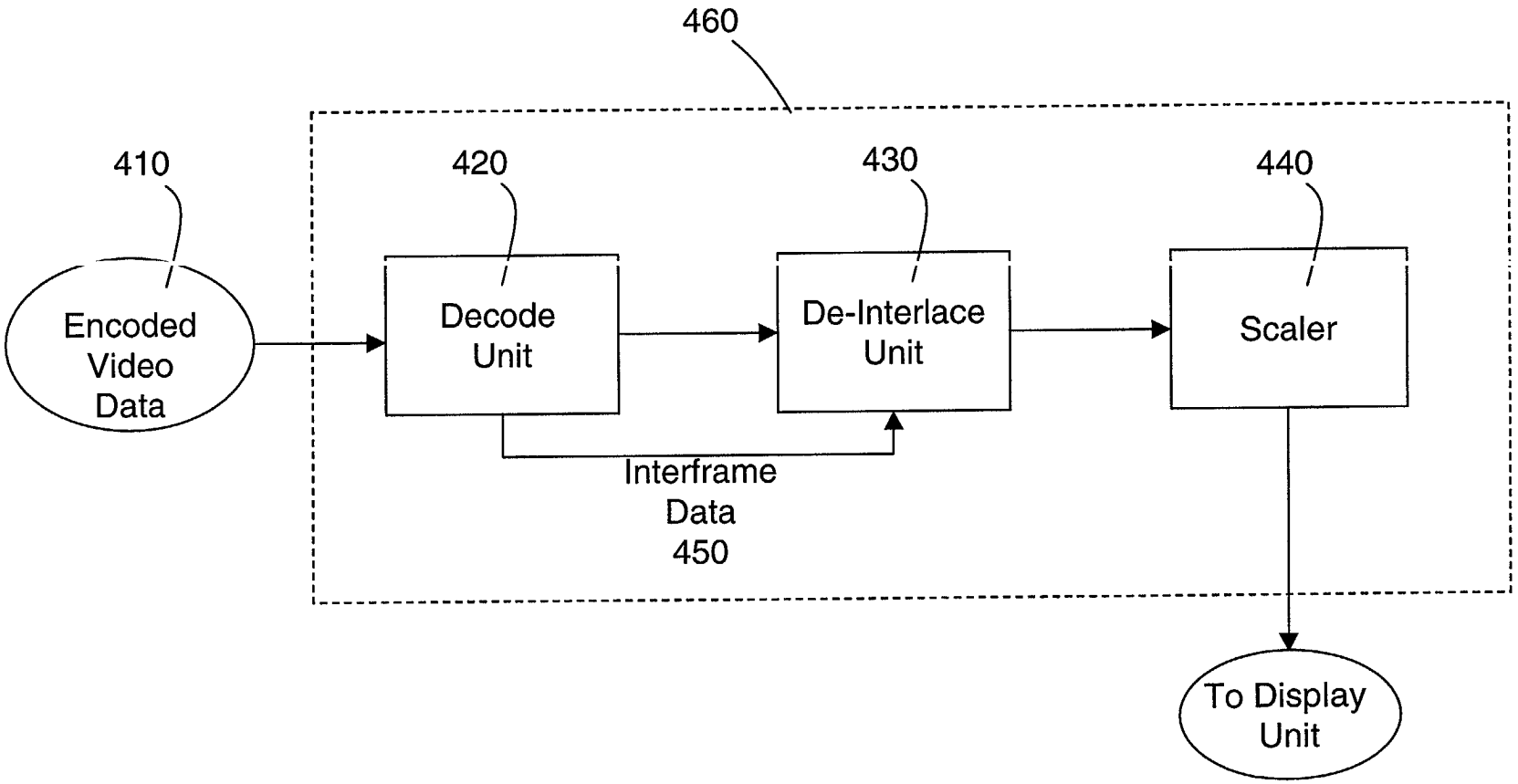

FIG. 4

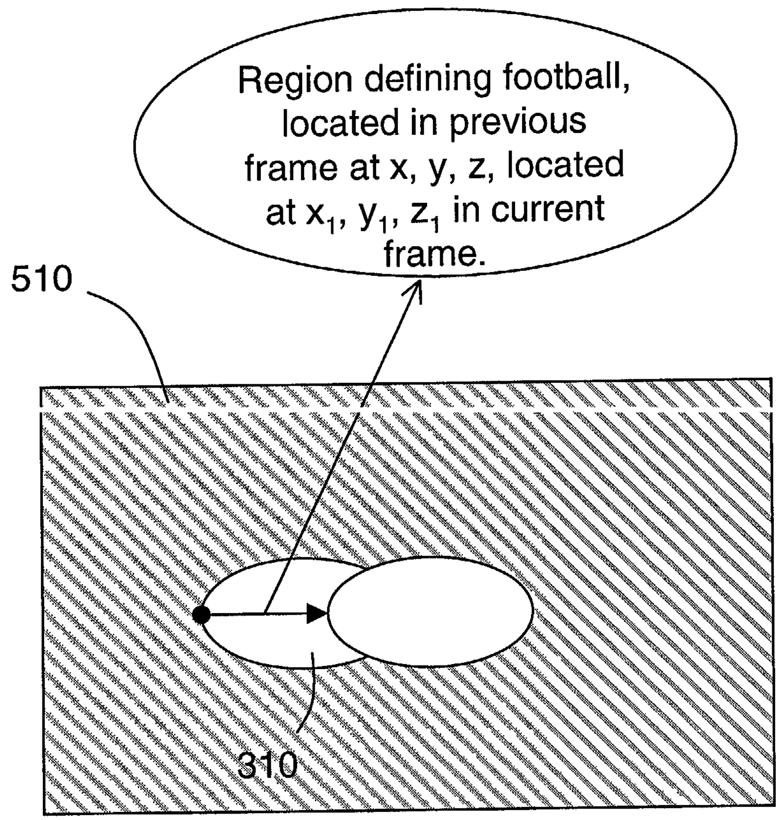
Region defining football, located in previous frame at x, y, z, located at x_1, y_1, z_1 in current frame.
510
310

FIG. 5

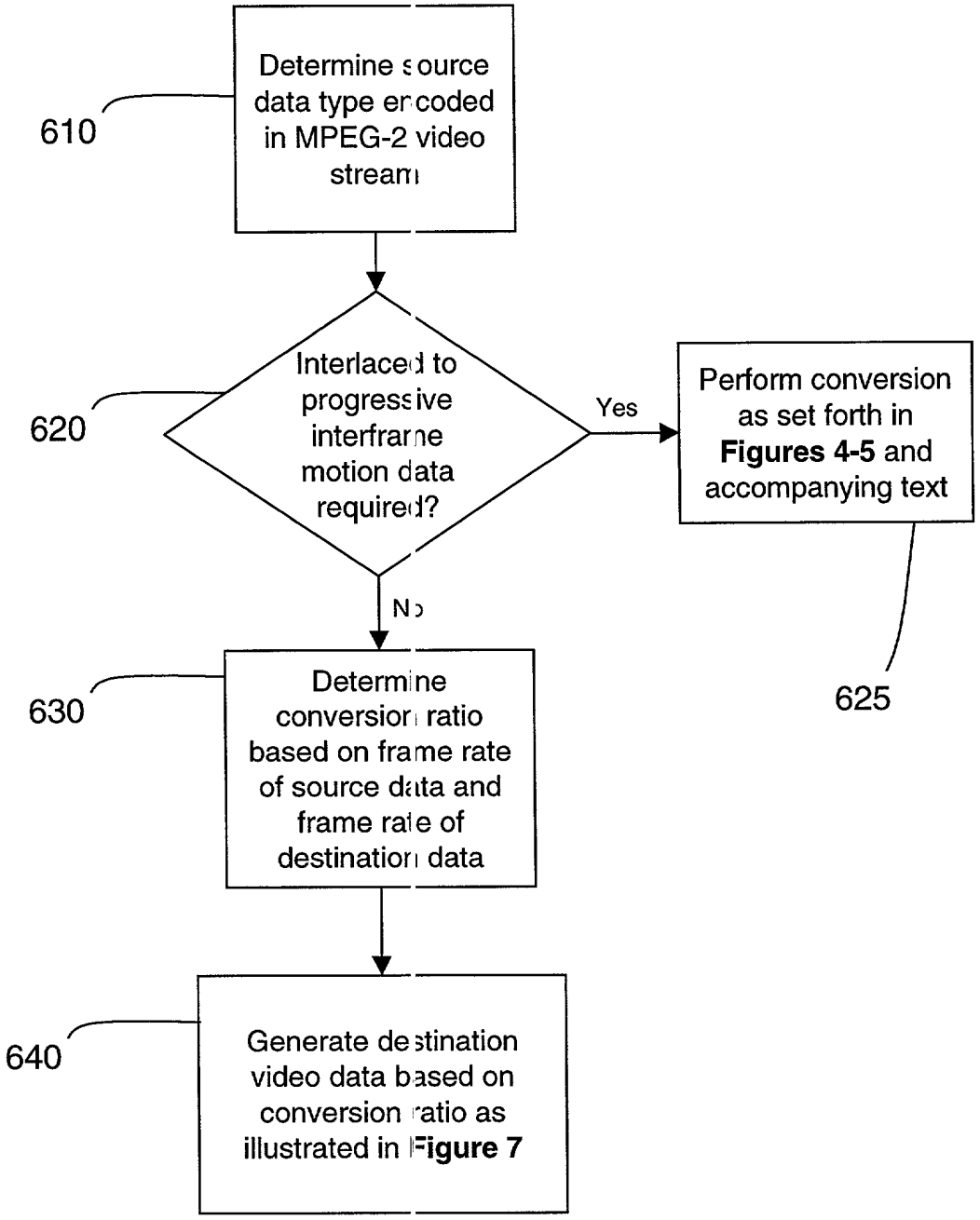
Determine source data type encoded in MPEG-2 video stream
610
Interlaced to progressive interframe motion data required?
620
Yes
Perform conversion as set forth in **Figures 4-5** and accompanying text
625
No
Determine conversion ratio based on frame rate of source data and frame rate of destination data
630
Generate destination video data based on conversion ratio as illustrated in **Figure 7**
640

FIG. 6

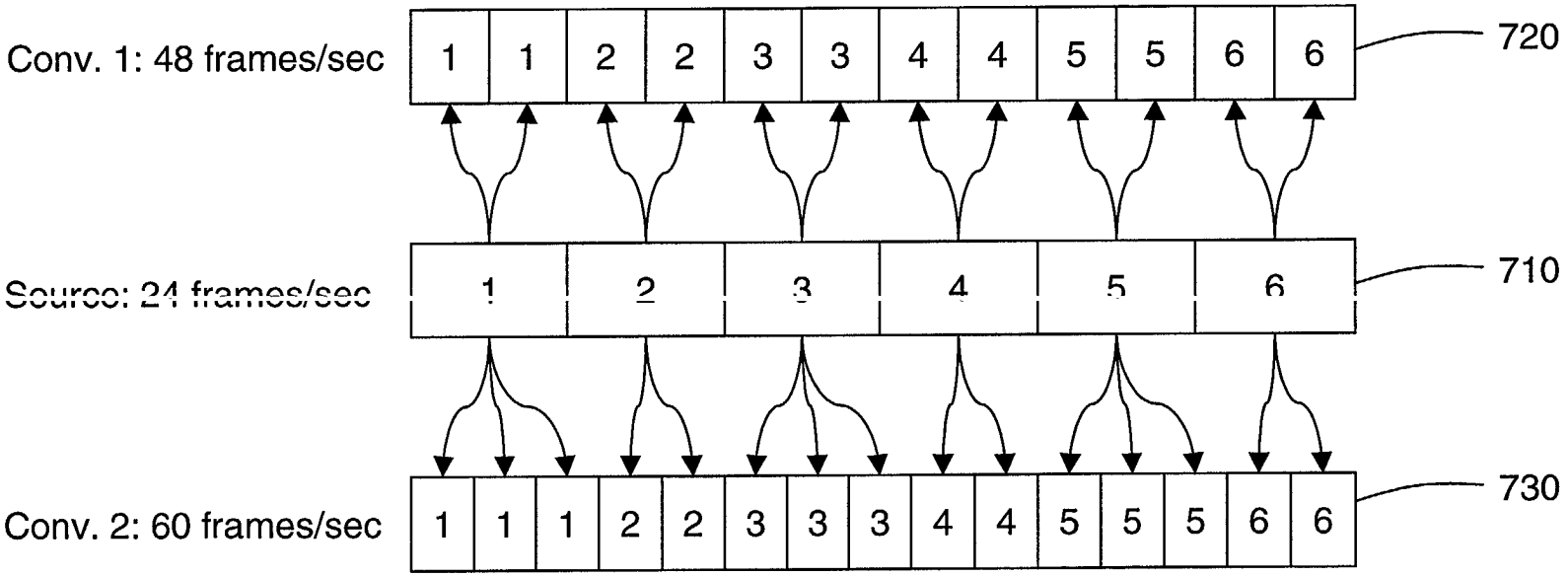

FIG. 7

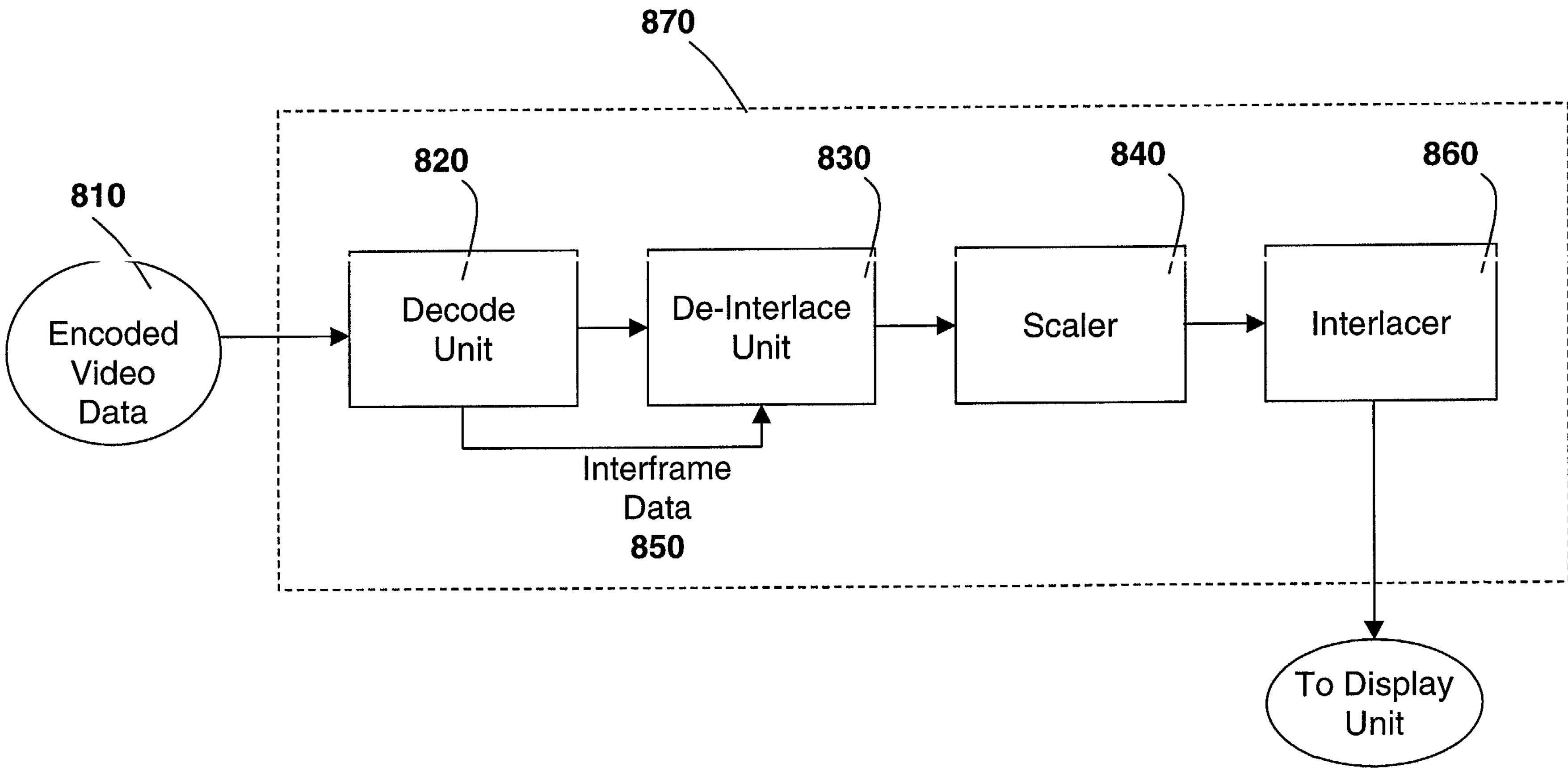
870
810
820
830
840
860
Encoded Video Data
Decode Unit
De-Interlace Unit
Scaler
Interlacer
Interframe Data
850
To Display Unit

FIG. 8

Attorney's Docket No.: 004259.P003 Patent

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SYSTEM AND METHOD FOR PERFORMING INTERLACED-TO-PROGRESSIVE CONVERSION USING INTERFRAME MOTION DATA

the specification of which

_x_ is attached hereto.
___ was filed on _____ _____ as
United States Application Number _____
or PCT International Application Number _____
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below:

(Application Number)	Filing Date
(Application Number)	Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112 I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Number)	Filing Date	(Status -- patented, pending, abandoned)
(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

I hereby appoint the persons listed on Appendix A hereto (which is incorporated by reference and a part of this document) as my respective patent attorneys and patent agents, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to Thomas C. Webster (Name of Attorney or Agent), BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP, 12400 Wilshire Boulevard 7th Floor, Los Angeles, California 90025 and direct telephone calls to Thomas C. Webster (Name of Attorney or Agent), (408) 720-8598.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's Signature ____________ Date ____________

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APPENDIX A

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APPENDIX B

Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.